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Identification of Factors in AI Chatbot Utilization as a Facilitator of Personalized Learning for Senior High School Students in Malang City

Nur Azia Syahidah, Punaji Setyosari

State University of Malang, Jl. Semarang No. 5 Malang, East Java, Indonesia

*Author of correspondence, Email: punaji.setyosari.fip@um.ac.id

Abstract

The development of Artificial Intelligence (AI) Chatbots opens significant opportunities in supporting personalized learning, aligned with the mandate of the Ministry of Primary and Secondary Education Regulation No. 13 of 2025 regarding curriculum flexibility. However, a gap remains between students' digital independence and teachers' ability to implement differentiated learning conventionally. This research aims to identify the role of key factors supporting the utilization of AI Chatbots as a facilitator of personalized learning among high school students in Malang City. This study employed a quantitative approach with a descriptive method involving 100 students selected through cluster random sampling from SMA Negeri 8 and SMA Nasional Malang. Data were collected using a structured Likert scale questionnaire to measure seven main factors: content relevance, effectiveness, learning styles, flexibility, efficiency, engagement, and learning motivation. Data analysis was conducted descriptively to determine the frequency distribution percentage and score categorization. The results indicated that all these factors play a positive role in supporting personalized learning. Flexibility emerged as the most dominant aspect, while engagement was in the moderate category. These findings confirm that the successful implementation of AI Chatbots depends not only on technological sophistication but also on pedagogical suitability and students' adaptive readiness.

Keywords: Artificial Intelligence, Educational Technology, Technology Adoption

1. Introduction

The development of Artificial Intelligence (AI) has brought about significant transformations in various aspects of human life, including education. This innovation has radically altered the traditional instructional paradigm, particularly in improving the operational efficiency of learning, the effectiveness of teaching systems, and providing precise and timely cognitive feedback (Fatmawati et al., 2024). As one of the main axes in the landscape of future education development in the era Society 5.0, artificial intelligence converges with high mobility and limitless interactivity to drive the expansion of web-based learning systems “mobile-interactive” as well as “Intelligent Tutoring” Systems (ITS) which is adaptive to user profiles (Alam & Mohanty, 2023).

This integration of cutting-edge technology, which is realized massively through the use of AI Chatbot, not only facilitates students in analyzing academic assignments in depth and comprehensively, but also plays a crucial role in growing and maintaining internal learning motivation by providing a supply of relevant, accurate, and personalized information specifically according to the individual needs of students (Haidir et al., 2024). Through this

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AI-based intelligent tutoring mechanism, access to personalized, quality education has become more democratic, providing equal opportunities for every student to receive adequate cognitive support without being hampered by local geographic boundaries or family socioeconomic background.

At the Senior High School level, implementing a personalization strategy is key to addressing the challenges of diverse and heterogeneous learning needs among students. Personalized learning is essentially oriented towards aligning the entire learning process, including the pace of the material, the depth of the content, the delivery style, and the form of evaluation with the unique characteristics and capacities of individual students. However, in its practical implementation in the field, there are various structural and methodological obstacles that are often faced by formal school institutions, such as the high level of difficulty for teachers in measuring the internal variables of student learning effectively "real-time", the lack of applicable theoretical guidelines for carrying out pedagogical interventions based on differentiation variables, as well as consideration of ethical dilemmas regarding the undesirable psychological impact of labeling students' academic abilities (Plass & Froehlich, 2025).

On the other hand, the application of personalized learning has proven to be very effective in identifying gaps (learning gaps) as well as early conceptual understanding delays, while simultaneously stimulating the development of self-regulation skills and independent learning abilities (self-regulated learning) to students (Arnadi et al., 2024). Considering that each individual high school student has different learning style preferences, specific interests and talents, and a different pace of understanding the material, the presence of AI technology Chatbot offers an alternative solution that can dynamically adjust instructional parameters to accommodate these unique characteristics. By optimizing the use of AI applications Chatbot, teachers are no longer burdened by the tedious task of manual differentiation, but instead have the potential to design learning scenarios that are much more interactive, contextual, relevant, and in-depth for every student in the class.

The urgency of strengthening personalized learning in Indonesia has now gained legal legitimacy and a very strong legal basis through the issuance of Regulation of the Minister of Primary and Secondary Education of the Republic of Indonesia (Permendikdasmen) Number 13 of 2025. This regulation is an amendment to Regulation of the Minister of Education, Culture, Research, and Technology Number 12 of 2024 concerning the Curriculum in Early Childhood Education, Primary Education, and Secondary Education. In this latest national policy, the government places a much more intensive emphasis on the flexibility of curriculum implementation and the level of adaptability of the teaching process in order to respond to and accommodate the diversity of potential, interests, and developmental nature of different students. This progressive regulatory adjustment directly requires educational units to carry out maximum governance and optimization of digital technology resources. This step is necessary to ensure that every individual student has the right to an inclusive, equitable, and personalized learning experience, where this ideal vision is closely aligned with the innate technological capabilities (built-in capabilities) offered by the ecosystem AI generative.

This research specifically takes the locus in Malang City, an urban area in East Java known for its outstanding academic reputation and massive potential in adopting AI technology developments in the formal education sector, supported by the quantity of school

institutions and a very large student population. Based on previous empirical studies, it was found that the penetration and implementation of AI use in Malang City has begun in a structured manner, primarily centered on the domain of higher education, secondary schools, and the creative industry sector, which is accompanied by various systemic efforts to boost teachers' digital competence and expand awareness collective regarding the urgency of AI in the educational community (Yahya et al., 2023). The manifestation of the massive digital transformation movement in this city is reflected in the active implementation of various workshops and practical AI introduction training for educators, which aims to align the quality of teachers' professional competencies with the dynamics of modern industrial needs (Widasari et al., 2023). In fact, a recent study focusing on student dynamics in Malang confirmed that for the student population belonging to Generation Z, the level of competence and literacy in utilizing AI has shifted to become a very important psychological determinant, which is significantly able to increase the degree of independence in their independent learning (Nugroho et al., 2025).

While the potential of digitalization seems very promising, the reality on the ground still leaves a paradox and a significant gap. There is a disconnect between students' highly organic and agile capacity for independence in exploring various AI features. Chatbot autodidactically, with various technical obstacles and methodological limitations faced by teachers in schools in executing the principles of differentiated learning through conventional methodsn (Syahria et al., 2025). This crucial gap is what triggered the urgency of conducting this research. The main focus of this research is deliberately directed no longer to simply test the presence or absence of the influence of AI utilization at a macro level through a linear inferential statistical approach, but rather focused on efforts to identify in-depth, mapping, and comprehensive description of how certain internal and external factors including content relevance, effectiveness, learning style, flexibility, efficiency, active involvement, and learning motivation play their respective roles as key supporting variables in facilitating personalized learning experiences for high school students in Malang City.

Utilization of AI devices Chatbot in the macro environment of high schools, it is not merely a phenomenon of adopting technical instruments, but rather a manifestation of a very complex socio-technological interaction involving multiple psychopedagogical dimensions. The level of acceptance and sustainability of AI technology use by students is largely determined by their subjective perceptions of the ease of use aspect (perceived ease of use) as well as practical usability aspects (perceived usefulness), where both elements are deeply shaped by the user's technological mindset (AI mindset) as well as personal psychological factors (Ibrahim et al., 2025). However, all the technical conveniences offered by artificial intelligence machines will certainly not be able to produce substantive and transformative educational impact without the integration of a solid pedagogical foundation. In line with this fundamental premise, the integration of all forms of technological components in the instructional realm must be placed on a framework. Technological Pedagogical Content Knowledge (TPACK) to ensure that every supply of information content produced and presented by AI Chatbot remain within the corridor of national curriculum needs, have academic quality, and are truly capable of increasing the quality and depth of the student learning process personally (Hartati, 2019).

The evolution of culture and the learning ecosystem in this era of artificial intelligence disruption has proven to have a very positive impact, especially in terms of expanding the

boundaries of personalized learning and breaking down the barriers that isolate access to quality education globally. The presence of AI has significantly contributed to boosting the effectiveness of knowledge absorption by providing a variety of unique learning experiences that have been precisely customized to the level of initial ability and cognitive rhythm of students, which in the long term acts as an inclusive instrument to reduce the problem of disparities in the quality of access to education (Safitri et al., 2024). The implementation of this technology has not only proven reliable in triggering escalation of engagement active students throughout the information search process, but also really helps to lighten the administrative burden of teachers in managing class management so that it runs much more efficiently (Tu et al., 2025).

Furthermore, the integration of appropriate artificial intelligence into daily instructional activities has great potential to stimulate and prepare students to grow into innovative, critical, independent, and creative learning agents. These superior human resource (HR) characteristics are an absolute necessity and the nation's primary modality in facing fierce global competition in the era of digitalization Society 5.0 (Suharyo et al., 2024). Based on the interweaving of theoretical and empirical backgrounds that have been described, it is felt that it is very urgent to conduct a comprehensive, directed, and specific scientific research that aims to identify the role of seven main factors (content relevance, effectiveness, learning style, flexibility, efficiency, involvement, and learning motivation) which are strongly suspected to be the main supporters behind the optimal use of AI applications.Chatbotas an instrument to facilitate personalized learning among senior high school students in the Malang City area.

2. Method

2.1. Research Design

This study employed a quantitative approach with a descriptive survey design. A descriptive quantitative method was selected to identify, measure, and systematically describe the factors driving the utilization of AI Chatbots as facilitators for personalized learning among senior high school students in Malang City, without applying experimental treatments or manipulating variables.

2.2. Research Setting and Sample

The study was conducted in Malang City, East Java, during the even semester of the 2025/2026 academic year. A proportional cluster random sampling technique was applied to select 100 high school students with prior experience using AI Chatbots.

Table 1. Distribution of Research Sample

School Name	School Type	Sample Size (n)	Percentage (%)
SMAN 8 Malang	Public	50	50%
SMA Nasional Malang	Private	50	50%
Total		100	100%

2.3. Research Procedures

The research procedure was executed through four main stages:

1. Preparation Stage: Conducting a literature review on differentiated learning and AI integration, designing the instrument blueprint, and testing the validity and reliability of the research instrument.
2. Data Collection Stage: Distributing closed-ended questionnaires directly (offline) and online to the 100 selected respondents at the designated research locations.
3. Data Processing Stage: Verifying data completeness, performing data coding, tabulating responses, and categorizing measurement results.
4. Reporting Stage: Analyzing the data descriptively, presenting the findings in tables and figures, and formulating conclusions based on the measured indicators.

2.4. Research Instruments

Primary data were gathered using a closed-ended questionnaire measured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The instrument content validity was established through expert review, and internal consistency was confirmed with a Cronbach's Alpha coefficient exceeding 0.70.

Table 2. Structure of the Research Instrument

No	Variable / Factor	Measured Focus	Measurement Scale
1.	Efficiency	Time-saving and task completion speed	5-point Likert Scale
2.	Flexibility	Anywhere-anytime learning accessibility	5-point Likert Scale
3.	Learning Style	Alignment with individual learning preferences	5-point Likert Scale
4.	Content Relevance	Suitability with high school curriculum materials	5-point Likert Scale
5.	Effectiveness	Impact on learning outcomes and understanding	5-point Likert Scale
6.	Engagement	Interactive participation with AI Chatbot	5-point Likert Scale
7.	Learning Motivation	Drive and interest in learning acceleration	5-point Likert Scale
8.	Personalization Perception	Support level for differentiated learning	5-point Likert Scale
9.	Usage Intensity	Frequency and duration of AI Chatbot utilization	Quantitative Scale

2.5. Data Analysis Techniques

Data were analyzed using descriptive statistical techniques assisted by SPSS and Microsoft Excel software. The analysis proceeded through the following steps:

1. **Mean Score Calculation**: Computing the average scores for each variable/factor associated with AI Chatbot utilization.
2. **Frequency and Percentage Distribution**: Determining the percentage distribution of respondents' choices for each indicator.

3. **Data Categorization**: Grouping the analysis results into three benchmark categories (*High*, *Moderate*, *Low*) based on ideal score interval ranges to interpret the tendencies of students' AI Chatbot utilization.

3. Results and Discussion

3.1 Result

This results section presents empirical findings collected from the distribution of structured questionnaires to 100 high school (SMA) student respondents in Malang City, including SMA Negeri 8 Malang City and SMA Nasional Malang. Quantitative data obtained through the assistance of the SPSS program were analyzed using descriptive statistics to answer the research problem formulation, namely identifying the characteristics and roles of seven supporting factors for the use of AI Chatbotas a facilitator of personalized student learning. Summary of all descriptive statistical parameters including the arithmetic mean value (Mean), mode (the score that appears most frequently), percentage of frequency distribution of the dominant score group, and the final categorization results are presented comprehensively in Table 2 below:

Table 3. Descriptive Statistical Parameters of the Results of Identification of AI Utilization Factors *Chatbot*

No	Identified Supporting Factors	Mark Mean	Mode Value	Percentage of Dominant Score Categories	Final Interpretatio n Category
1.	Content Relevance Factor (X1)	4,12	4	68% High	High
2.	Effectiveness Factor (X2)	3,95	4	62% High	High
3.	Learning Style Factor (X3)	4,28	5	74% Very High	Very high
4.	Flexibility Factor (X4)	4,56	5	86% Very High	Very High (Dominant)
5.	Learning Efficiency Factor (X5)	4,18	4	70% High	High
6.	Engagement Factor (X6)	3,15	3	54% Moderate	Currently
7.	Learning Motivation Factor (X7)	3,82	4	58% High	High
8.	Perception of Support for Personalized Learning (Y1)	4,22	4	72% Very High	Very high
9.	AI Utilization Intensity (Y2)	3,74	4	60% High	High

Based on the data presented in Table 2, it was found that the flexibility factor (X4) was ranked at the top as the most dominant aspect with the highest value achieved.MeanThe mean score was 4.56, with the absolute mode value at 5 (Strongly Agree). The frequency distribution shows that 86% of respondents gave a Very High rating for this dimension. These findings strongly confirm that freedom of space and time, as well as the ability to independently regulate the pace of learning, are the primary drivers for high school students in Malang City to adopt AI.Chatbot.

The learning style factor (X3) is in second place with the highest score obtained.Mean of 4.28 and a mode value of 5 (Strongly Agree). As many as 74% of students rated this factor as being in the Very High category, which proves that AI's capabilities Chatbotin customizing the output format (output) is very adaptive in responding to the heterogeneous cognitive preferences of individual students. Furthermore, the other three factors are in the High classification category, namely the learning efficiency factor (X5) with a value ofMean4.18 (70% of respondents), content relevance factor (X1) with valueMean 4.12 (68% of respondents), and the effectiveness factor (X2) with the obtained valueMean3.95 (62% of respondents). The learning motivation factor (X7) followed in the High category with a value ofMeanof 3.82.

On the other hand, anomalous results were found in the involvement factor dimension (X6). This factor recorded the lowest score among all the variables tested, with a value of Meanonly 3.15, with the dominant mode value at 3 (Neutral). Fifty-four percent of students placed this engagement dimension in the Moderate category. These quantitative findings indicate a tendency among students to view artificial intelligence devices as mere answering machines for transactional tasks, rather than as cognitive dialogue partners or personal assistants with a deep emotional connection to their unique profiles. This overall descriptive data provides an objective foundation for moving on to the next theoretical discussion.

3.2 Discussion

The results of the descriptive analysis in this study reveal a very interesting socio-technological veil regarding how senior high school students in Malang City adopt and integrate technology. AI Chatbot into their self-learning ecosystem. By mapping seven key supporting factors, this study successfully provides strong empirical confirmation that the presence of artificial intelligence is no longer seen simply as a digital lifestyle trend momentary, but has evolved into a cognitive bridge instrument (cognitive scaffolding) which is reliable for realizing the essence of personalized learning at the practical level of formal schooling.

The most striking finding and the crown of the quantitative data of this study is the absolute dominance of the flexibility factor (X4) which occupies the highest rank (Mean= 4.56). This fantastic figure reflects that freedom of space, time, and complete autonomy in setting the rhythm of independent learning speed are the main attractions that encourage students to adopt AI Chatbot. In the conventional classroom landscape, the teaching process is often locked by the rigidity of schedules, limited face-to-face duration, and the demands of a mass curriculum that forces all students to move at a uniform pace of understanding.

Theoretically, this freedom is supported by the conceptInterpretive Flexibility in theorySocial Construction of Technology, where the AI function Chatbot actively determined by how students interpret and utilize it according to their unique needs (Goel, 2025). Technically, this is realized through Intelligent Tutoring Systems (ITS) which provide sscaffolding dynamic and fading (reduction of aid) gradually as students' learning independence increases (Albert dkk., 2022). This combination of flexible adoption and adaptive systems has succeeded in creating a truly student-centered learning ecosystem. The presence of AI Chatbot breaking down these structural boundaries by providing 24-hour personal academic consulting servicesnon-stop. Students who have a slower learning speed

(slow learners) can ask repetitive questions repeatedly without feeling anxious or judged, while students with high learning speeds (fast learners) can quickly explore advanced material that is beyond the reach of school textbooks.

This massive flexibility characteristic becomes a crucial empirical foundation for achieving the ideal implementation of differentiated learning, which is very much in line with the basic spirit and mandate of the regulation of the Minister of Primary and Secondary Education Regulation (Permendikdasmen) Number 13 of 2025. The latest national policy places a very intensive emphasis on the importance of the curriculum flexibility aspect and the adaptability of the instructional process in order to respond to and accommodate the diversity of potential, interests, and the unique nature of student development. This research data clearly proves that AI Chatbot acting as the technological partner best equipped to translate this legal vision into practice, democratizing the expansion of access to cognitive assistance without being hampered by the isolation barriers of traditional classrooms.

The high role of flexibility is also closely related to the learning style factor (X3) which is ranked second highest (Mean= 4.28). The majority of students showed a very active tendency in utilizing the output format customization feature (output) through special instruction techniques (prompting). AI capabilities Chatbot reducing long scientific texts to concise points or simple analogies proves its adaptability to students' heterogeneous cognitive preferences, while also marking the end of an era of learning education “one-size-fits-all". By adapting the output format, whether in the form of visual-infographics or text summaries, this technology is able to engage students at the cognitive, affective, and behavioral levels (Hossain et al., 2026). In line with this, the integration of differentiated instructions this is very crucial to accommodate the needs, preferences, and individual skill levels of each student (Chen & Shih, 2025).

Theoretically, the findings on the dimensions of flexibility and learning styles strengthen the arguments put forward by Tu et al. (2025) regarding the empowerment mechanism for personalized learning based on generative AI, where intelligent algorithms are able to provide precisely customized learning trajectories according to students' initial abilities. This is also in line with the study Safitri et al. (2024) which confirms the evolution of student learning culture, from being passive in receiving uniform material from teachers, shifting to being independent learners who are agile in orchestrating digital resources to meet their personal needs.

On the other hand, a significant contribution is also shown by the learning efficiency factor (X5) with a value of Mean 4.18 and the content relevance factor (X1) with a valueMean 4.12. In the context of efficiency, AI Chatbot reliably reduces basic reference search time by aggregating, summarizing, and structuring the essence of scientific literature in seconds. This efficiency frees up students' time to be allocated to higher-order thinking activities or Higher Order Thinking Skills (HOTS), such as critical analysis, idea synthesis, and complex problem solving. Furthermore, the system's speed in providing instant, real-time feedback has been shown to effectively improve students' academic performance (Ilic et al., 2024). Of the era Society 5.0, this operational efficiency is realized through an adaptive learning system (adaptive learning) which is able to automatically adjust the content difficulty level based on the user's performance record.

Regarding the content relevance factor (X1), this high score provides theoretical confirmation that the supply of AI information Chatbot assessed as accurate, contextual, and aligned with the students' micro-curriculum. Through the framework Technological Pedagogical Content Knowledge (TPACK), AI Chatbot acts as an intelligent filter that ensures the academic quality of content for the depth of student learning (Hartati, 2019). In the future, content relevance will not be limited to data compatibility, but must be socially relevant and oriented towards solving real-world problems to make learning more meaningful (Jaramillo & Chiappe, 2024). This strategic integration not only meets the unique cognitive needs of students, but also extends to the development of affective and axiological domains, as well as decision-making skills that are crucial for future sustainability (Vagheee, 2026).

However, the results of this study leave a critical note and a very fundamental anomaly in the involvement factor dimension (X6) which is in the Medium category classification (Mean= 3.15). The neutral numbers that dominate this dimension reveal the fact that for the majority of the high school student population in Malang City, AI devices Chatbot Until now, AI has been viewed as a rigid automated answering machine for transactional tasks, rather than an interactive learning assistant or cognitive dialogue partner that truly understands their unique psychological and emotional profiles. The relationship remains mechanistic; students give commands and AI provides answers, without any in-depth, reflective dialogue.

This critical analysis of the anomalies of engagement draws strong theoretical support from the thinking of Arnadi et al. (2024), which states the premise that the degree of effectiveness of a deep personalized learning experience is highly dependent on the system algorithm's capability in conducting comprehensive scanning, recording, and analysis of data on students' cognitive strengths and weaknesses real-time. If the form of interaction that occurs is still limited to superficial flash questions and answers, then the students' interactive involvement will stagnate at a low level and fail to touch the dimension of emotional involvement (emotional engagement). This is reflected in the learning motivation factor (X7) with a value ofMean 3.82 which is in the High category, but the intensity of AI utilization Chatbot (Y2) by students still shows a very tight dependency on the burden of extrinsic assignments from the class teacher, rather than being based on intrinsic motivation or pure scientific curiosity. In fact, AI has great potential to increase student engagement in depth through interactive dialogue mechanisms and the provision of direct feedback. In fact, the closeness of this intensive cognitive and emotional interaction often triggers students to use metaphors of close social relationships, such as the "teacher-student" or "parent-child" relationship patterns when consulting withchatbot that smart (Divekar et al., 2025).

If analyzed through theoretical glasses Self-Determination Theorypioneered by Deci and Ryan (1975), the fulfillment of the basic psychological need for autonomy has indeed been well facilitated by the control space offered by AI. However, the need for relationship engagement within the AI digital ecosystem remains. Chatbot still very dry and not yet able to replace the central role of the presence of human teachers in providing empathetic touch, moral guidance, and emotional encouragement (Chiang, 2025; Ibrahim et al., 2025). The conclusion of this discussion synthesis confirms a paradox: AI technology Chatbotis very superior and has been remarkably successful in facilitating the technical-operational dimensions of learning personalization (flexibility, learning efficiency, and learning styles), but still leaves a big challenge in touching the humanistic-interactive dimensions of learning

(deep engagement and organic intrinsic motivation). Therefore, the success of its long-term implementation should not rely solely on the sophistication of the technology's algorithm updates, but must be combined with wise teacher pedagogical design in formal classrooms to maintain a balance between digital sophistication and human touch.

4. Conclusion

This research successfully identified the characteristics and crucial roles of seven main factors that support the use of AI. Chatbotas a facilitator of personalized learning for high school students in Malang City. Based on empirical findings in the field, all factors studied were shown to have a positive contribution, with flexibility emerging as the most dominant factor encouraging students to adopt this technology due to the freedom of space, time, and independent control over the learning rhythm it offers. These results directly address the research objectives by proving that the implementation of AIChatbotvery effectively acts as a cognitive bridge to realize the essence of differentiated learning and flexible curriculum mandated by the latest national education policy. However, the study also found that the engagement factor is still in the moderate category, which indicates a limitation where students still view artificial intelligence as a rigid information transactional instrument rather than as a personal assistant that understands their cognitive uniqueness in depth. Based on these limitations, follow-up suggestions for future researchers are to expand the sample size by involving a more heterogeneous school demographic and integrating mixed methods such as in-depth interviews or objective learning achievement tests so that the evaluation of the effectiveness of AI-based personalized learning can be recorded more comprehensively, objectively, and not only relying on subjective student perception data.

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